NASA SBIR/STTR Technologies

X7.02 – An Advanced Cooling System for In-Situ Resource Utilization

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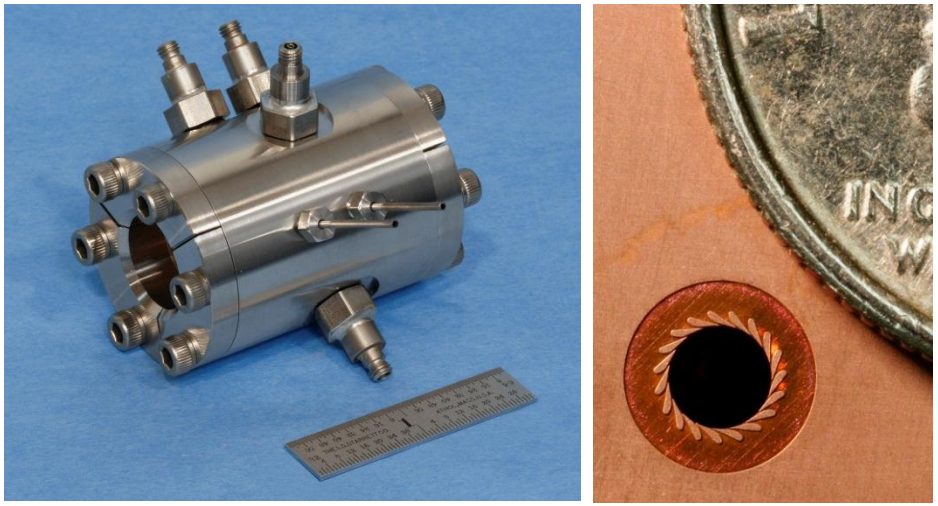
Proposal 08-2 X7.02-9609

Identification and Significance of Innovation

NASA plans to produce cryogenic oxygen and hydrogen to power regenerative fuel cells for lunar surface exploration. The oxygen and hydrogen will be produced by electrolysis of water from In Situ Resource Utilization reactors. The electrolysis products will be warm high-pressure gases, requiring significant cryocooler power to achieve desired storage conditions. This power can be reduced by expanding the gases adiabatically from the electrolysis pressure to storage pressure. We developed innovative turbo-alternator technology to maximize this effect and convert the extracted fluid power into useful electric power. Cryogenic gas bearings and miniature rotor fabrication techniques are key features in our approach.

TRL at end of Contract (1-9): 4



Oxygen Turboalternator and Miniature Nozzle Ring Next to Dime

Technical Objectives and Work Plan

The primary goal for the Phase II project was to fabricate and test a prototype turbomachine. This accomplishment matured our approach and enhanced its readiness level for ISRU systems and other applications. We focused on the oxygen turboalternator because it has the greatest impact on the overall system performance, and it has the greatest technical challenges. The primary activities we completed are listed below.

1. Completed Detailed Design of Turboalternator
2. Developed Critical Fabrication Processes
3. Fabricated and Assembled Turboalternator
4. Demonstrated Rotordynamic Operation at Design Speed
5. Measured Performance at Ambient Temperature

NASA and Non-NASA Applications

The primary NASA application is cryogenic reactant production to fuel extraterrestrial exploration and science. The approach is broadly applicable for a variety of fluids and environments. Another potential NASA application is re-liquefaction of boiled cryogens created during in-space refueling of orbital spacecraft. Private sector applications focus on production of cryogenic fluids for gas separation, superconductors, MRI systems, material conditioning, cyrogenic manufacturing, academic research, cryogenic storage, re-liquefaction of LNG boil-off, and liquid hydrogen production for automotive fuel cells. Broader uses include improved efficiency for turbo-Brayton cryocoolers and power generators, which have numerous NASA, DoD, and civilian applications.